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PICATINNY ARSENAL

DOVER, NEW JERSEY

SAMUEL FELTMAN AMMUNITION LABORATORIES

BOMB, MINE AND G M WARHEAD SECTION

TECHNICAL MEMORANDUM NO. 46B14

TITLE: EVALUATION OF THE 73 MM STRIM RIFLE GRENADE

BY: WILLIAM W. TRUSZ
PFC. JOHN P. DONAHUE
WILLIAM M. CONWAY

DATE: OCTOBER 1957

COPY NO. 19 OF 44

ORDNANCE PROJECT NO. TA3-5923D

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AMMUNITION DEVELOPMENT LABORATORY B

BOMB, MINE AND GM WARHEAD SECTION

Technical Memorandum No. 46514

EVALUATION OF THE 73mm STRIM RIFLE GRENADE

BY

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Ordnance Project No.: TA3-5923D

Date October 1957

ABSTRACT

A total of 105 STRIM 73mm Rifle Grenades were examined and tested to determine the performance of this item.

Dynamic firing tests were conducted with 15 STRIM grenades; 14 penetrated at least 9 inches of armor at angles of obliquity up to 65° and one grenade functioned prematurely at the rifle muzzle. In previous tests conducted by the Canadian Armament Research and Development Establishment, the average armor penetration at normal angle of attack was 12.3 inches. The minimum armor penetration of the M31 (T37E4) Rifle Grenade is 7 inches, while the average armor penetration at normal angle of attack is 9.5 inches. The maximum range of the STRIM Grenade with STRIM Launcher and cartridge was 263 yards; with the M7A3 Launcher and M3 cartridge, the range of the STRIM grenade was 201 yards. The maximum range of the M31 Rifle grenade is 230 yards.

The probable error of the STRIM Rifle grenade at 100 yards was 8 inches horizontal, 11 inches vertical; comparable values for the M31 Grenade are 7 and 10 inches horizontal, 12 and 13 inches vertical.

Study of the fuze in the STRIM Rifle grenade showed the omission of several important safety features.

OBJECTIVE

The object of this study was to evaluate the 73mm STRIM Rifle grenade, with particular emphasis on the following:

a. Operational reliability and capability against armored vehicles.

b. Comparative performance in relation to that of the M31 Rifle grenade.

CONCLUSIONS

a. The STRIM grenade is not safe enough for use as a standard Ordnance Item and would require major redesign of the fuze to meet Ordnance Corps requirements.

b. The 73mm STRIM Rifle grenade is superior to the M31 Rifle grenade from the standpoints of armor penetration and range, but the M31 is superior in safety.

RECOMMENDATIONS

1. The STRIM Rifle grenade should not be used by United States troops in view of the proven danger that it may explode upon being fired.

2. In view of the indicated lack of need for an improved rifle grenade (Ref. a) no further consideration should be given to the use or redesign of the STRIM grenade.

INTRODUCTION

a. General Description

The 73mm STRIM ANTI-TANK Rifle grenade is designed to penetrate armored vehicles. The grenade may be fired from a .30 cal. M1 Rifle, using either the M7A3 Grenade Launcher or the French STRIM Launcher.

Figure 1 shows the French drawing for the grenade assembly, Figure 2 is a Picatinny Arsenal study drawing of the fuze, Figure 3 presents a photograph of a complete and disassembled round of the STRIM grenade and Figure 4 shows a radiograph of a complete round. The over-all size is approximately 2.88 inches in diameter by 17.35 inches long; the weight is 1.78 pounds. By comparison, the M31 Rifle grenade is 2.62 inches in diameter, 16.96 inches long and weighs 1.60 pounds.

b. History

The 73mm STRIM Rifle grenade was designed and developed by the French Government. A program of demonstration of the grenade was set up by the Marine Corps and comparative tests between the Energa Rifle grenade and new French STRIM were conducted during November 1952 at the Marine Corps Development Center, Quantico, Virginia (Ref. b). Further evaluation of the grenade was accomplished through determination of the dynamic penetration of homogeneous armor by the Canadian Armament Research and Development Establishment, Valcartier, Quebec, during the period from October 1953 to January 1954 (Ref. c). In January 1953, Picatinny Arsenal was requested to conduct a complete evaluation of the French Grenade in order to determine the possibility of adopting this grenade as an Ordnance Corps Item (Ref. d). It was also requested that the 73mm STRIM be compared with the M31 Rifle grenade wherever possible.

TEST PROGRAM

1. Results of Testing

a. Dynamic penetration tests were conducted against 18 inches of armor plate using 15 grenades. One premature occured; in all other cases 9-inch armor would have been defeated. At 0° angle of obliquity 3 grenades penetrated 12-inches of armor plate and one grenade penetrated 9-inches. At 55° angle of obliquity, 5 grenades penetrated 9-inches of armor plate, and at 65° angle of obliquity 5 grenades penetrated 9-inches of armor plate. (Table I)

b. Static firing tests were conducted to determine the penetration obtainable with the 73mm STRIM grenade. A total of 49 grenades were fired against mild steel. Fifteen of these grenades were "as received" and 34 were reloaded using different explosives. The results show (Table II):

(1) All 15 original grenades penetrated at least 11 inches of mild steel, the average penetration being 14.0 inches.

(2) Reloading the grenades with 70/30 and 75/25 Octol increased the average penetration to 15.5 and 14.8 inches, respectively. However, with each of these explosives at least 1 grenade out of 12 penetrated less than 11 inches.

(3) Reloading the grenades with Composition B resulted in an average penetration of 13.3 inches.

c. The range of the STRIM grenade was determined by firing 15 grenades. Maximum range using the M7A3 Launcher and M3 Rifle Grenade Cartridge was 201 yards, using the M7A3 Launcher and the STRIM Cartridge it was 240 yards, and using the STRIM Launcher and STRIM Cartridge the distance was 263 yards. (Table III)

d. Dispersion tests were conducted using 22 grenades. These rounds were fired using STRIM Cartridges and Launcher at targets 50, 100, 150 yards distant. Most firings were made at 100 yards. The results of the latter shots showed probable errors of 8 inches horizontal and 11 inches vertical. (Table IV) Comparison values for the M31 Grenade show errors of 7 and 10 inches horizontal and errors of 12 and 13 inches vertical.

e. Four STRIM grenades were disassembled and their fuzes subjected to Jolt and Jumble tests in accordance with MIL-STD-300 and MIL-STD-301 respectively. From these tests it appeared that the fuzes were Jolt and Jumble safe. However, owing to the small quantity of fuzes tested these results cannot be considered conclusive because evaluation and study of the STRIM fuze design indicate that it is unsafe.

2. Comparative Discussion of STRIM and M31 (T37E4) Grenades

a. Study of the fuze design showed that the STRIM fuze has no arming delay, no detonator safety, no self-destruction features, and no out-of-line explosive train feature. On the basis of this examination, the fuze is considered unsafe. The occurrence of the premature burst proves conclusively that the fuze is not safe.

b. Reference c reports the average armor penetration for the STRIM Rifle grenade to be 12.3 inches at normal angle attack (0° obliquity) and reports fuze functioning failure at attack angles of 55° and 65°. Picatinny Arsenal conducted similar tests but found, contrary to Ref. c, that the fuze in five out of five cases functioned at 55° and 65° angles of obliquity and that at these angles of attack the grenade penetrated 9-inches of armor plate.

At the angular displacement of 55°, tests of seven M31 Grenades resulted in a mean depth of armor penetration of 8.7 inches while at 0° obliquity the average armor penetration was 9.5 inches for 15 grenades (Ref. e).

c. Static penetration tests were conducted to determine the performance of the STRIM grenade without introducing interferences due to variations in fuze functioning time or other variables. It was recognized that the charge in the STRIM (50/50 RDX/TNT) was an explosive with a lower rate of detonation than the Composition B used in the M31 Grenade. Accordingly, STRIM grenades were reloaded to determine what improvement in penetration could be achieved by use of a superior high explosive. The standard STRIM gave an average penetration of 14.0 inches of mild steel compared to 13.3 inches when reloaded with Composition B. STRIM grenades reloaded with 75/25 Octol gave an average penetration of 14.8 inches and those reloaded with 70/30 Octol gave an average penetration of 15.5 inches. (Table II)

d. The maximum range of the STRIM Rifle grenade using the STRIM launcher and the STRIM cartridge is 263 yards. By comparison, the maximum range of the M31 Rifle grenade is 230 yards (Ref. f).

e. The dispersion characteristics of the STRIM are about equal to those of the M31 even though the M31 Rifle grenade shows yaw visible to the naked eye when fired. The STRIM flies in a smooth trajectory. It is believed that the fins of the STRIM may be better than those of the M31.

f. Considering the STRIM Rifle grenade as a unit, it is approximately 10% heavier and larger than the M31 Rifle grenade and hence, it is not surprising that it is more effective. The increase in average depth of penetration is approximately 25%, which is somewhat more than would be expected from the size increase. Since the STRIM cartridge is more potent than the M3, the usable range of the STRIM is comparable to that of the M31 Rifle grenade.

Also, there are no significant differences in accuracy. Against this evidence of good penetration and the minor differences in range and accuracy, the weakness of the unsafe fuzing of the STRIM Rifle grenade looms large. It is questionable whether sufficient gain would accrue to warrant redesign of the STRIM Rifle grenade fuzing.

g. Reference a, received before evaluation of the STRIM Rifle grenade was completed, indicates that the need for an improved rifle grenade no longer exists. Accordingly, no further consideration of the STRIM Rifle grenade is recommended.

3. Test Procedure

a. Dynamic Penetration tests - the STRIM grenades were fired from an M7A3 launcher using an M1 30 cal. rifle and an M3 rifle grenade cartridge. The target consisted of six three-inch-thick armor plates. The mount was placed 25 yards from the target. Upon completion of the tests, the targets were separated and penetration measured as units of 3-inch armor perforated.

b. Static Penetration tests - Grenade heads, containing all explosive with the exception of the detonator, were placed on top of a stack of 20 one-inch-thick mild steel plates, using a stand off equal to the length of the ogive. The grenades were initiated by special Signal Corps electric blasting caps. The penetration was measured by removing the plates and then drilling out the last plate to determine penetration to the nearest tenth of an inch. (See Figures 5 and 6)

c. Maximum Range test - a cal. 30 M1 Rifle was mounted on a stand adjustable in the verticle direction. The mount was adjusted to a starting angle of 36° and increased by steps of one degree to 47°. Five rounds were fired at each setting with an M7A3 Grenade launcher and an M3 Grenade cartridge. The cartridge was then changed from the M3 cartridge to the STRIM and the procedure repeated. Finally the M7A3 Grenade launcher was changed to the STRIM and the above procedure was again repeated. Table III gives the results of the above combinations at the maximum range angle.

d. Dispersion tests - Inert rounds were fired from a stationary mount using an M1 Rifle, a STRIM grenade cartridge, and a STRIM launcher. The plywood targets were set at a distance of 50, 100 and 150 yards.

4. Manufacturing Analysis

The STRIM Rifle grenade is basically simple and is well designed from the standpoint of ease of manufacture. It consists largely of drawn aluminum parts which are assembled in large part by use of plastic adhesive bonds. There are relatively few machining operations involved. The double-angled tapered-wall copper cone is unique. It is judged to have been manufactured by spinning followed by a finishing machine operation. The only other critical material evidenced was the use of tungsten carbide for the firing pin core. This is a small piece and it is probably essential that it be of high density to insure uniform fuze functioning upon impact.

5. Acknowledgement

Appreciation is expressed to Mr. J. D. Hopper for conducting the reloading studies of the subject grenade with Octol and Composition B.

REFERENCES

a. Ltr., from OCO, ORDTA to PA 0.0./6C20473, 8 Oct 1956, Subject: Grenade, Rifle, M31, w/M211 Fuze (U)

b. Marine Corps Equipment Board, Quantico, Virginia, Program for Demonstration of STRIM 73mm HEAT Rifle Grenade, 19 Nov 1952.

c. Report Number Q-12/54, Jan 1954, Canadian Armament Research and Development Establishment.

d. Ltr., from OCO, ORDTA to PA 0.0.471.61/3(C), ORDBB 471.61/5-3, 12 Jan 1953, Subject: STRIM Rifle Grenade.

e. Aberdeen Proving Ground Firing Record P-53974.

f. Picatinny Arsenal Technical Report No. 2362, Final Engineering Evaluation of the T44 Practice Rifle Grenade Oct 1956.

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	14
TOTAL	33

TABLE I

Results of Dynamic Firing Tests of 73mm STRIM Rifle Grenade Against Armor Plate

Rd No	Obliquity, Degrees	Penetration, inches[a]
1	0	12
2	0	12
3	0	12
4	0	9
5	0	b
6	55	9
7	55	9
8	55	9
9	55	9
10	55	9
11	65	9
12	65	9
13	65	9
14	65	9
15	65	9

Depth of penetration determined as units of 3-inch armor plate perforated.

Round detonated at rifle muzzle.

TABLE II

Results of Static Firing Tests of Original and Reloaded 73mm STRIM Rifle Grenades Against Mild Steel

Explosive Loading:	Original[a]	Comp B	70/30 Octol[b]	75/25 Octol[b]
Penetration, inches:	15.5	15.1	18.0	16.8
	14.8	14.5	15.7	10.4[c]
	12.9	8.6[c]	16.3	15.4
	13.0	16.1	12.9[c]	17.1
	11.8	14.5	15.7	17.3
	11.4	11.6	9.0[c]	17.5
	15.1	14.0	17.2	10.9[c]
	14.7	15.5	15.1	15.0[c]
	13.5	8.9[c]	17.0	10.8[c]
	13.6	14.6	16.8	16.1
	14.5	13.0[c]	18.0	15.3[c]
	15.5		14.4[c]	
	15.3			
	14.7			
	14.2			
Average Penetration, Inches:	14.0	13.3	15.5	14.8
Total No. of Shots:	15	11	12	11

a. Original loading - a composition of 50% RDX and 50% TNT.

b. 70/30 Octol consists of 70% HMX and 30% TNT; 75/25 Octol consists of 75% HMX and 25% TNT.

c. Evidence of multiple jets in targets.

TABLE III

Range Characteristics of 73mm STRIM Rifle Grenade fired from .30 Cal. M1 Rifle using different Launchers and Cartridges

Launcher:	M7A3	M7A3	STRIM
Cartridge:	M3	STRIM	STRIM
Firing Elevation:	42°	44°	42°
Range, yards:	196	238	260
	205	240	259
	199	244	264
	201	239	266
	202	241	266
Average Range, yards:	201	240	263

TABLE IV

Dispersion of 73mm STRIM Rifle Grenade fired from a .30 Cal. M1 Rifle using STRIM Launcher and Cartridges

Range, yards:	50		100		150	
Elevation, degrees:	7		12		12	
No. of Shots:	5		11		6	
Error, inches:	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
	7	8	26	24	3	25
	2	8	12	5	16	22
	11	1	1	5	18	2
	5	2	12	24	1	27
	4	1	32	22	9	14
			1	6	29	5
			7	10		
			8	15		
			25	7		
			23	16		
			5	3		
Error, Standard Deviations, Inches:	7.3	5.7	18.1	16.4	17.4	20.3
Probable Error, Inches:	4.9	3.8	8.1	11.0	11.7	13.7
Probable Error of M31 Rifle Grenade w/M3 Cartridge[a]:						
w/M7 Launcher	2.7	5.0	6.9	13.0	6.2	54.8
w/M7A2 Launcher	1.3	2.9	10.3	12.1	12.6	36.3

a. Aberdeen Firing Record P-53974.

Coupe longitudinale

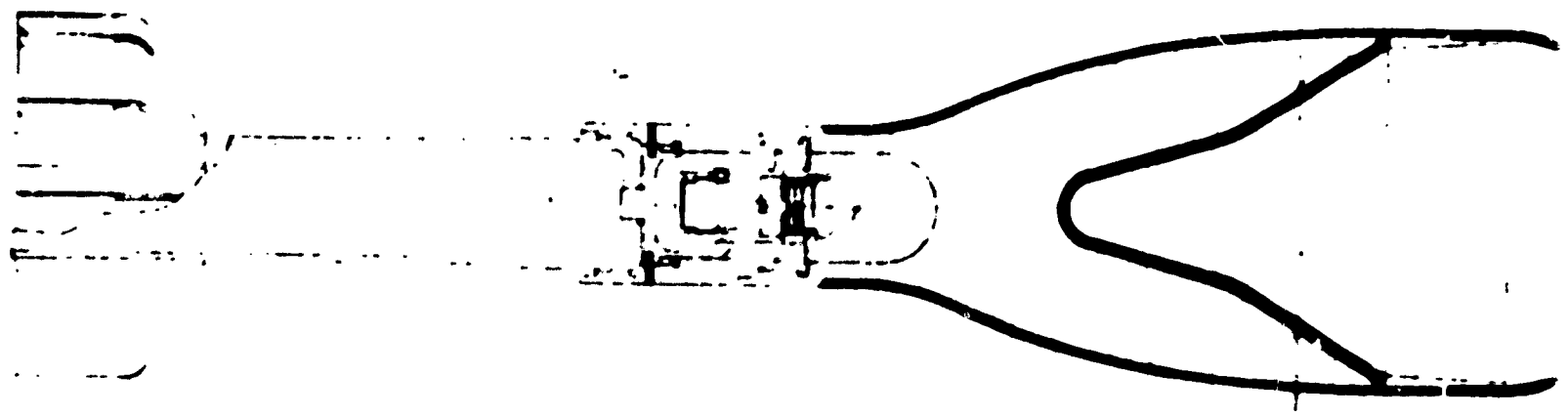
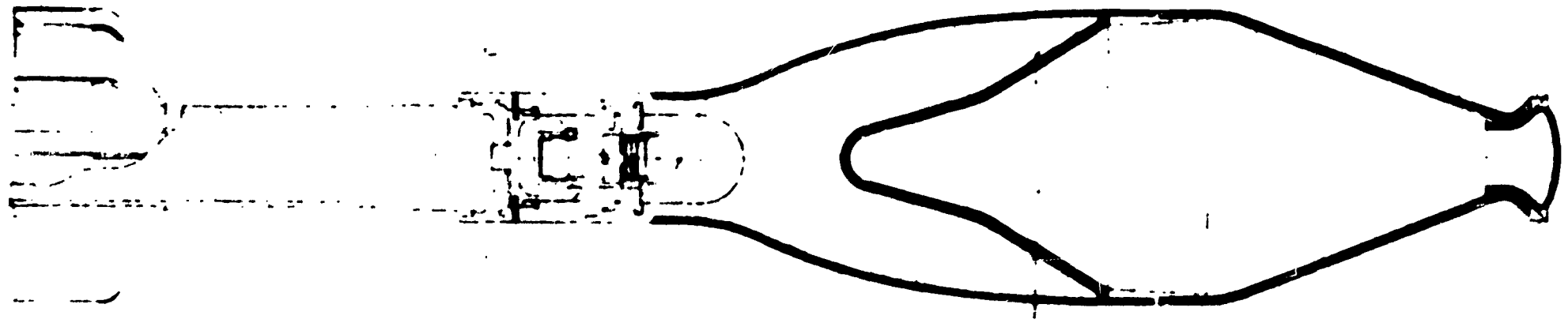


FIG. 1

Coupe longitudinale



Vue suivant A

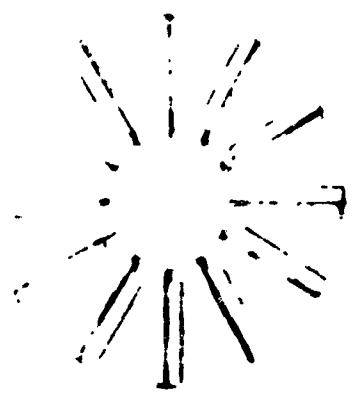


FIG. 1

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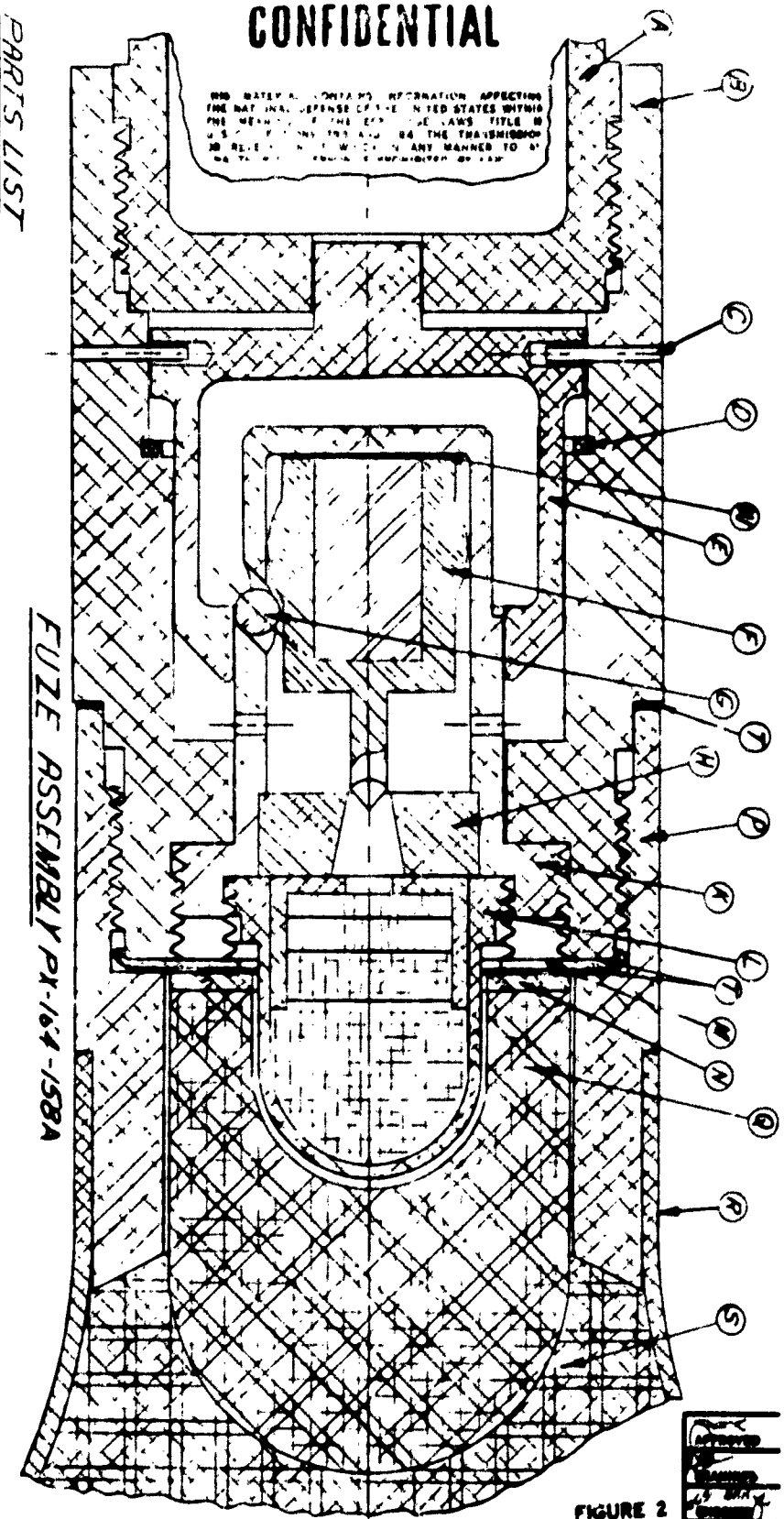

FUZE ASSEMBLY PX-154-1BA

PARTS LIST

A-STABILIZER ASSEMBLY.
B-FUZE BODY.
C-SHEAR PIN.
D-WASHER.
E-FUZE ARMING SLEEVE.
F-FIRING PIN ASSEMBLY.
G-RETAINER BALL (3)
H-FIRING PIN SPRING.
J-CUP.
K-FIRING PIN HOLDER.
L-DETONATOR ASS'Y.
M-CLOSING SEAL ASS'Y.
N-GASKET
P-UNION
Q-BOOSTER PELLET
R-BODY
S-BURSTING CHARGE
T-CEMENT SEAL.
W-FIRING PIN SPRING.

FIGURE 2

SCALE, INCHES 4

GRENADE, RIFLE, HEAT, STRIM, 73MM, FUZE ASS'Y DETAIL. STUDY DWG.

DRAWN
APPROVED
DATE OCT 28 1954 PX-154-158

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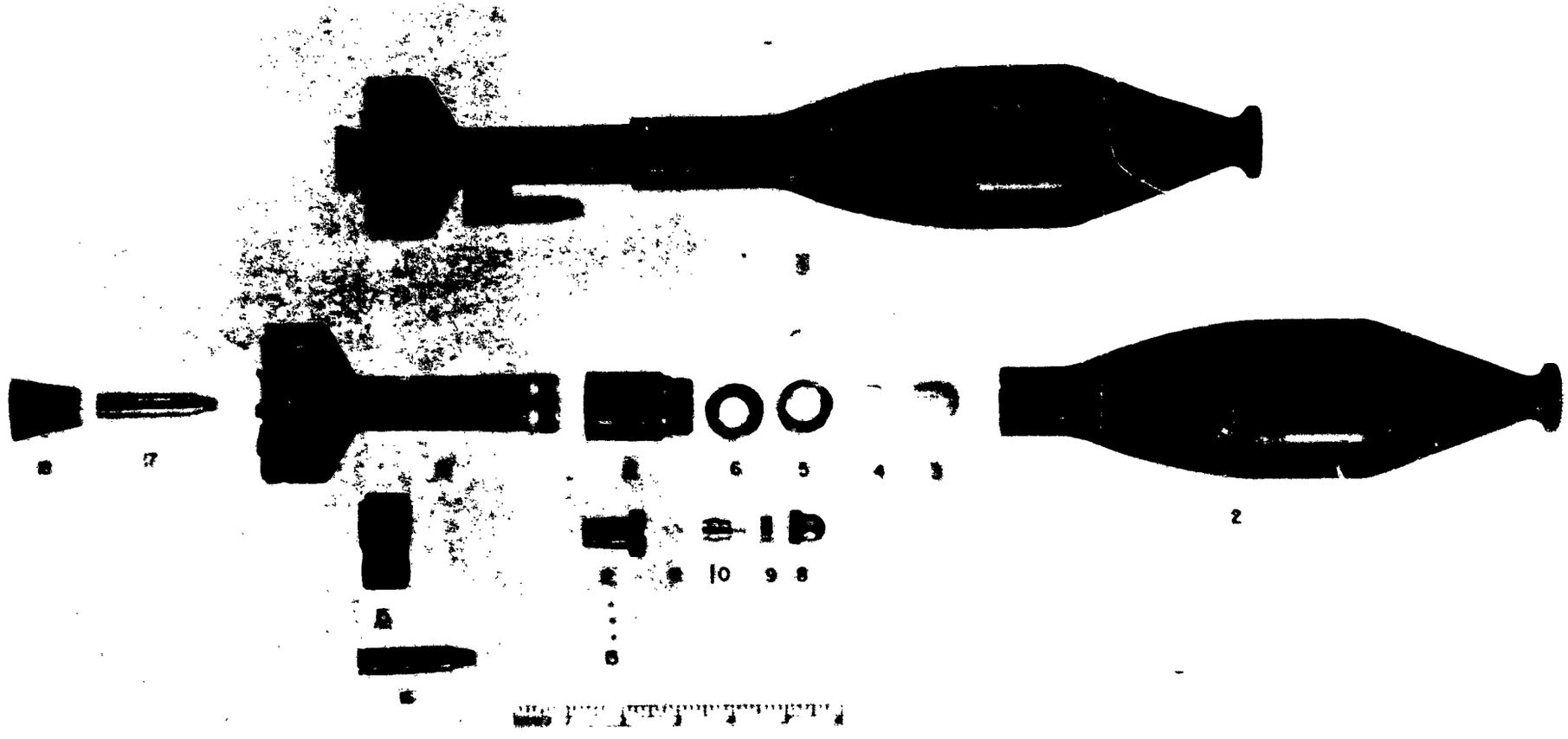
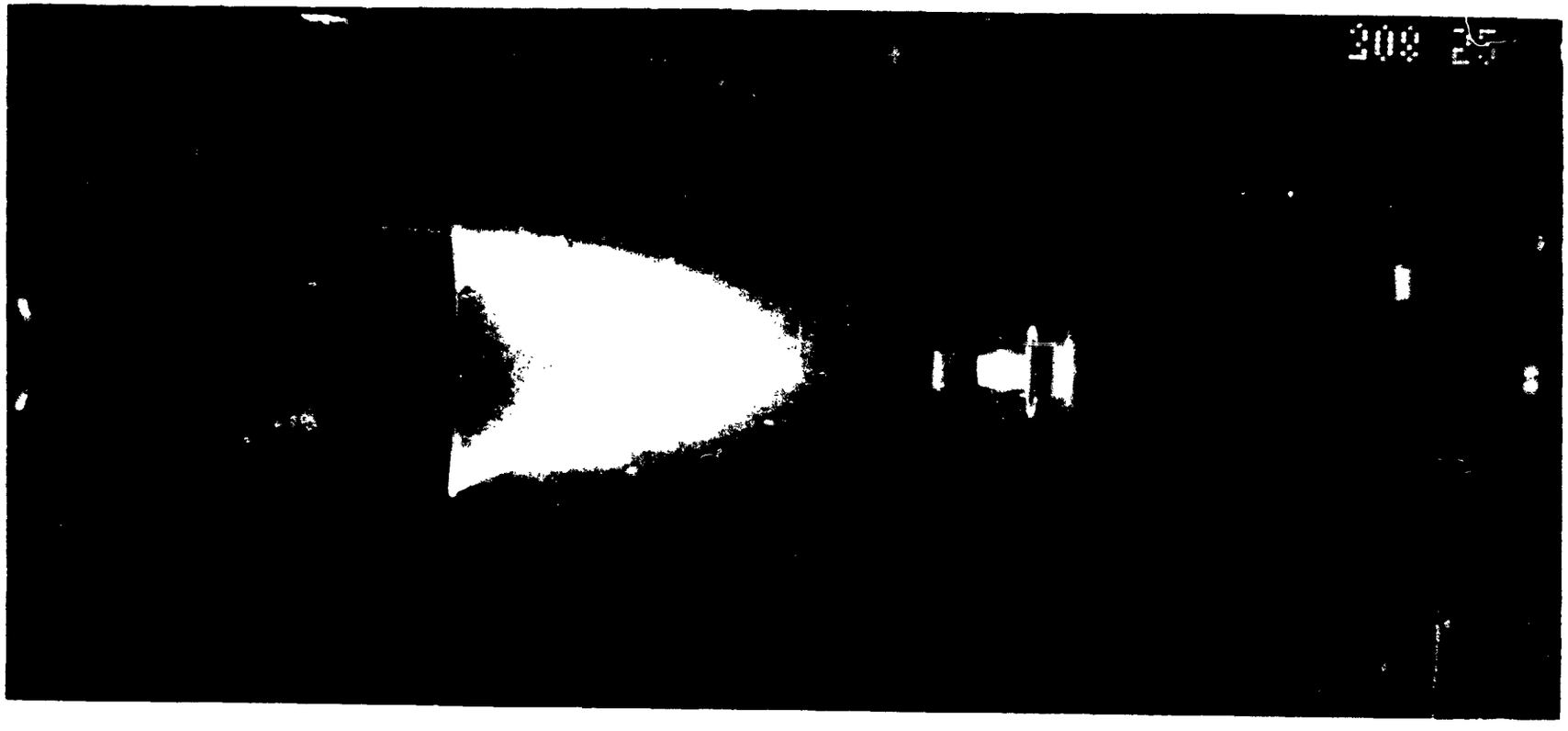


M-41735 June 1953 Picatinny Arsenal Ordnance Corps

Grenade, Rifle, HEAT, STRIM, 73mm
Project No. TA3-5911 I

1. Complete Round 2. Body Assembly 3. Booster Pellet 4. Gasket, Asbestos 5. Gasket, Celluloid 6. Cup, Charge 7. Fuze Body 8. Detonator 9. Firing Pin Retainer 10. Firing Pin 11. Disc, Paper 12. Firing Pin Holder 13. Balls 14. Stabilizer Assembly 15. Cartridge Clip, Holder 16. Cartridge 17. Extra Cartridge 18. Extra Cartridge Holder

FIGURE 3



M-42171 December 1952 PICATINNY ARSENAL ORDNANCE CORPS

Radiograph print of Grenade, Rifle, HEAT, STRIM

FIGURE 4

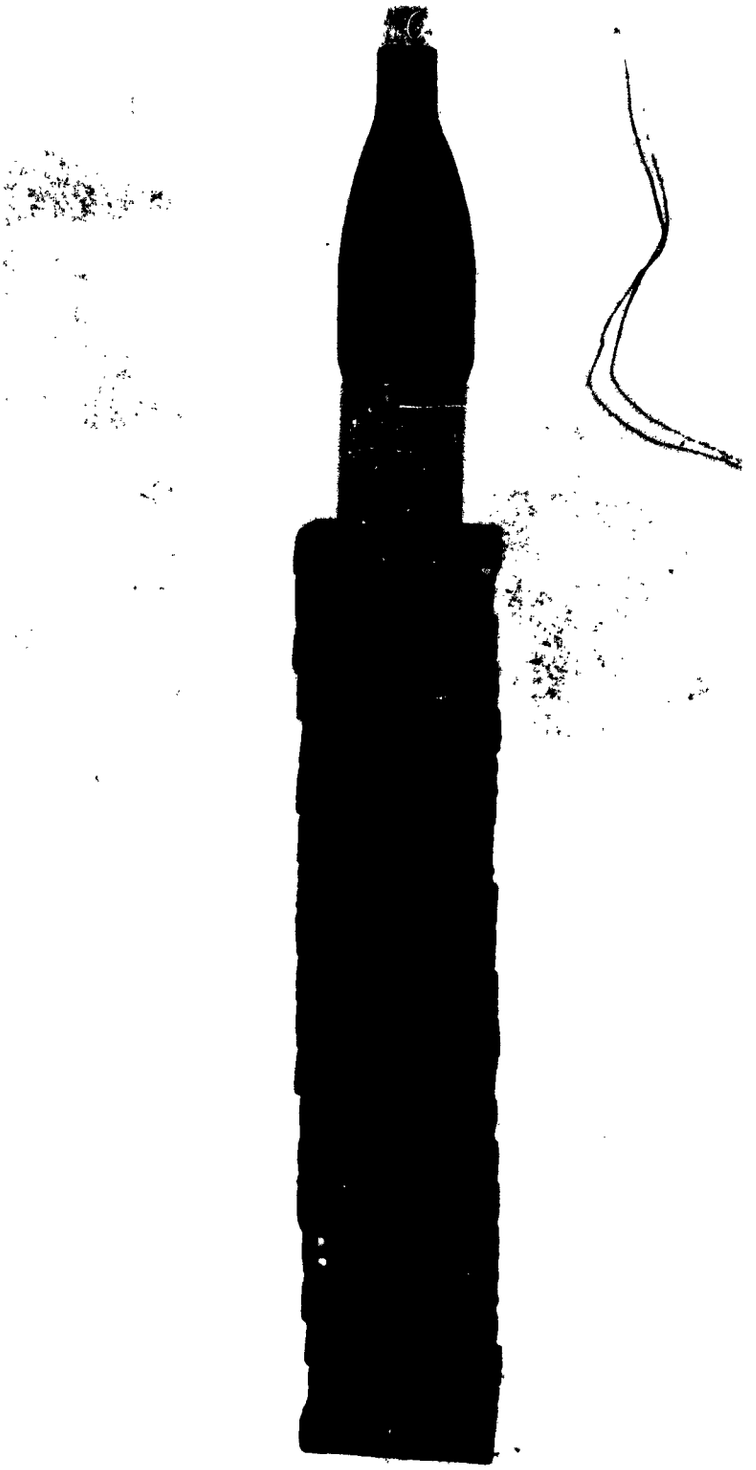


Fig. 5
Strim Grenade Static Penetration Test Setup

Fig. 6
Strim Grenade Static Penetration Test Plates - 70 30 Octol